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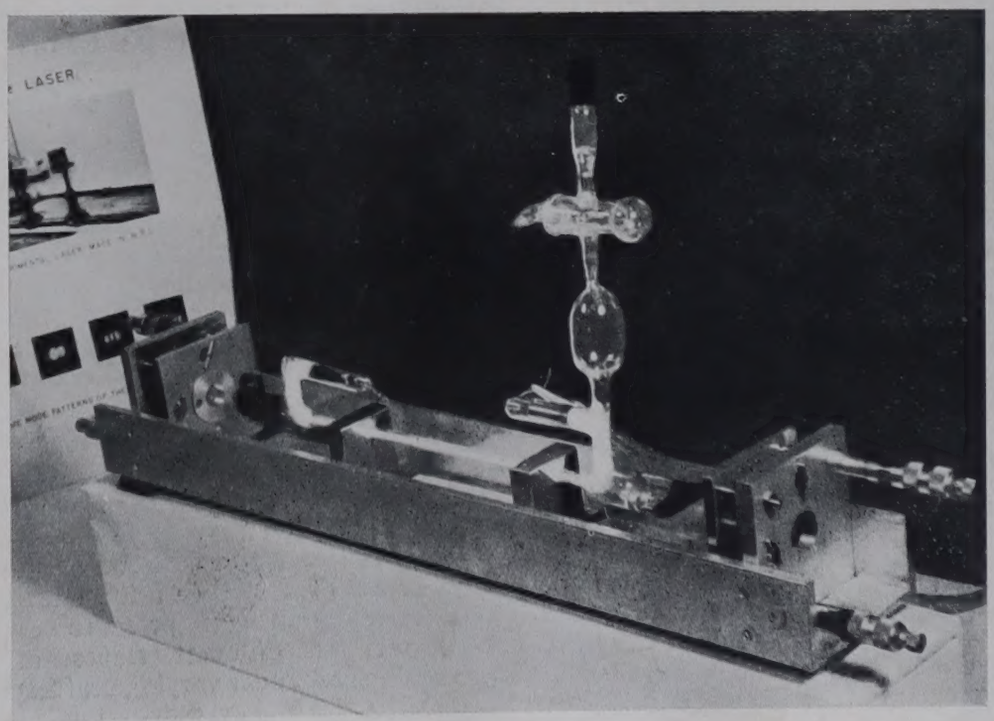
NPL Develops Helium-Neon Laser

Gas and solid state lasers are now increasingly used in research, communication and precision measurements. One of the latest applications of lasers is in holography or lensless photography for storing information. The National Physical Laboratory (NPL), New Delhi took up a project on the development of lasers needed particularly for use in optical measurements and metrology. For this purpose a laser emitting a beam of moderate power but with a high degree of coherence is required. Gas (single mode helium-neon) lasers are most suitable for metrological use.

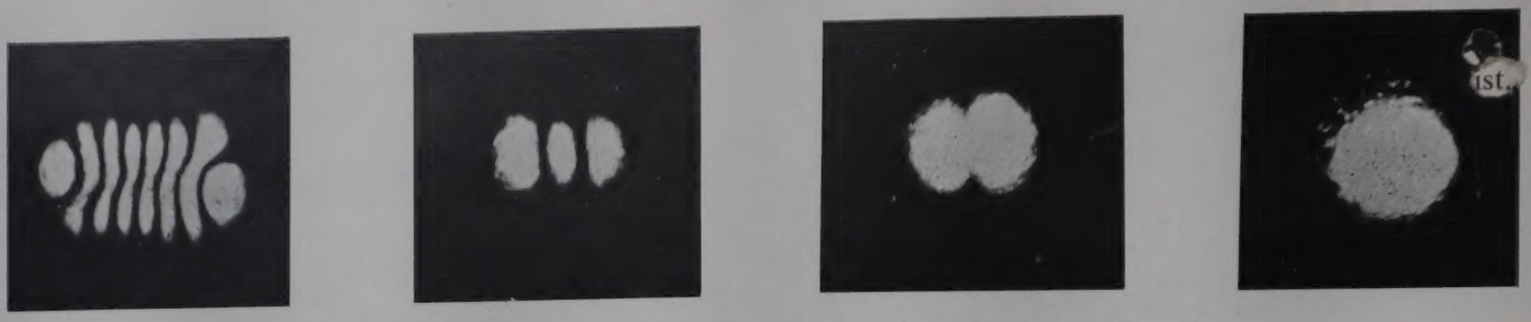
Helium-neon lasers emitting the visible 6328 A radiation have been developed by the laboratory. The first of these lasers, a Brewster window type with cold cathode dc excitation and of 22 cm active length, was put into operation in August 1969. A confocal resonator configuration was used. The laser gave a beam of 1 milliradian divergence with a coherence length exceeding 3 m. However, the power output was only 0·1 mW.

Considerable progress has been made in improving the power output, the coherence length and the life of the lasers and in making them more rugged. The governing factor in regard to improvements to the power output is the lowest mode operation. In this mode the laser beam has high degree of coherence required for optical and length metrology. To achieve this, laser tubes of different active lengths up to 45 cm with confocal, hemispherical and semi-confocal resonator configurations were tried. Dielectric coated mirrors of transmittance ranging from 2·3% to 0·3% were used in the resonators. The maximum power obtained till now is about 1 mW in TEM_{00} mode operation. This was obtained in a laser of 45 cm active length in a hemispherical resonator using mirrors of 2·3% and 0·5% transmittance respectively. Different types of excitation and electrode designs were tried to improve the life of the lasers. Direct current excitation using a large area anodized aluminium hollow cylinder for cathode was chosen. Life tests for lasers of such construction are being carried out. For ruggedness and portability, rigid mounts with sensitive mirror adjustment were designed and built for the Brewster angle lasers. Internal mirror lasers were also developed. The mirrors are directly sealed to the laser tube and hence permanently aligned. These lasers do not need Brewster windows, and emit unpolarized radiation.

All the components used in the lasers have been developed and made in the laboratory. For making lossless dielectric mirrors, a vacuum evaporation unit with two evaporation sources, a substrate holder with planetary rotation and an optical thickness monitor were built. The resonator mirrors used in all the lasers were coated in the evaporation unit with 13 to 19 layers of ZnS-MgF_2 or ZnS-cryolite films. A machine polishing method was developed for making thin, plane parallel, scatter-free Brewster windows. The high vacuum system built to fill the laser tubes with mixtures of helium and neon incorporates arrangements for purification of the gases. As a result, commercially pure gases available in the laboratory can be used. The vacuum system permits the filling of laser tubes with any desired partial pressures of the gases. The ends of the discharge tube have to be aligned precisely both in the Brewster window type and the internal mirror type



Helium-neon laser of the Brewster window type developed by NPL, New Delhi



Some mode patterns obtained in the helium-neon laser developed by NPL, New Delhi

lasers. Several jigs were designed and built to grind the ends of the laser tubes to the required degree of tolerances.

The different variations of He-Ne lasers built so far in the laboratory are: (1) Brewster angle type with (i) fused silica windows, (ii) optical glass windows, (iii) confocal resonator, (iv) hemispherical resonator, (v) semi-confocal resonator, (vi) cold cathode excitation, and (vii) hot cathode excitation; and (2) internal mirror type with (i) hemispherical resonator, and (ii) semi-confocal resonator.

Fifteen internal mirror type lasers are now being built for field trials. These will be supplied to the University Grants Commission for use in summer schools and to a few universities and research institutions.

Eleventh Textile Technological Conference

The eleventh Technological Conference, jointly sponsored by the Ahmedabad Textile Industry's Research Association (ATIRA), the Bombay Textile Research Association (BTRA), and the South India Textile Research Association (SITRA) was held in Coimbatore from 11 to 13 Dec. 1969. Thirty-one papers were presented in the following technical sessions: (1) operational studies, (2) mechanical processing—spinning, (3) mechanical processing—weaving, (4) textile chemistry, and (5) textile physics.

Operational studies

A. R. Garde and S. P. Deshpande (ATIRA) in their paper 'Linear programming (LP) for reducing mixing costs' have outlined a formulation of linear programming technique developed by them, which is simple, technologically sound and practicable. The essential features are: (1) mixings are formulated only on the basis of 4 to 5 important fibre properties which are individually kept at the desired level; (2) cottons are considered by name as in industrial practice; and (3) the desired level of fibre property is based mainly on the past experience of the mill concerned. Extensive case studies have been reported to show how mills have obtained substantial savings by utilizing available cotton suitably and by changing the purchase policy to meet the LP solution.

Mechanical processing—spinning

'Effect of tuft characteristics in blowroom on yarn properties' is the title of a paper by R. Sripathi (SITRA). The results of the study show that while opening the cotton to remove the trash, it is essential to ensure that the tufts are made into small and uniform size for producing even laps and better quality yarns. Also, higher variation in tuft size may cause significant short term variation in lap, count and strength variation in the yarn and the working will be poorer. Installation of beaters like Kirschner beater or saw-tooth opener at the final beating point may help reduce the variation in tuft size and consequently minimize the lap U%, C. V. of count and strength.

The paper by N. Balasubramanian and V. K. Bhatnagar (BTRA) provides basic information necessary for improving the quality of carded yarns as a result of a study of the effect of disorientation and presence of hooks at the different stages of processing and under varying drafting conditions. An interesting finding is that the use of a low break draft at the back zone of a two-zone speed frame results in excessive irregularities which are more prominent when majority hooks are fed as leading. Improved parallelization obtained by the use of a third passage of drawing helps reduce drafting irregularities and leads to better yarn quality provided a favourable direction of drafting is maintained at the ring frame.

The principle of operation of the air-vortex spinning is described in the paper presented by Ashok Hirway (BTRA). Theoretical concepts developed during the study regarding the behaviour of yarn in forced, free and practical vortices are dealt with. A theory of fibre assembly as well as experimental verification of the theory of assembly is given. The effect of varying the processing parameters on the quality of the yarn produced with the various vortex tubes is also detailed.

The effect of twist factor and blend proportion on the tensile properties of Terylene-polynosic blends has been studied by N. Balasubramanian and S. K. Nerurkar of BTRA. The study also highlights the modifications of the strength-twist relationship and the optimum twist brought about by blending. Terylene and F 40 staple fibres, of the same staple length and fineness, were chosen as blending constituents. The study showed that although the two fibres are of the same dimensions, their strength twist curves are markedly different; significantly higher strength realization is obtained with Terylene. The breaking strain of the yarn increases with Terylene content slowly up to 50% Terylene content, and thereafter more rapidly. The behaviour of a blend having 75% Terylene is similar to that of 100%, while that of blends with lower Terylene content is similar to that of F 40.

Mechanical processing—weaving

S. V. Ananthan, K. R. Subramanian and S. D. Mahajan (BTRA), in their paper 'Mechanism of fabric and selvedge curling' have shown that warp rib weave for the selvedge using double yarn equivalent to that of the body and medium denting of ends would provide the most suitable characteristics for a curl-free selvedge in processing these fabrics.

'Contribution of polyester content and fabric construction on the durability of PP garments' is the title of a paper by M. R. Ravikrishnan, M. J. Wadia and H. R. Chipalkatti (ATIRA), in which are discussed the properties of polyester cotton blends in general and the effect of different blending ratios on the performance characteristics. These properties are related to resin treatment particularly at the level of permanent press (PP). The performance characteristics of various blends at PP level are analysed on the basis of the experimental results. The paper shows that useful performance properties can be obtained from blends lower than the conventional.

In the high speed wet processing of cloth in rope form through J-boxes, saturators, washers, etc. the cloth acquires a large amount of false twist. As a result, the subsequent scutching process has to be interrupted to remove the accumulated twist. A cloth opening system which provides for the continuous opening of highly twisted cloth without interruption, developed at BTRA is described by C. V. Sastry and S. G. Shevade.

P. Neelakantan and M. C. Paliwal (ATIRA) in their paper 'Reed evaluation' describe a simple experimental set-up which enables the examination of at least four similar reeds in full (40 in. length) at a time. This is achieved by using a plane transmission grating with about 2000 lines/in. A suitable magnification of this grating can be made to give the required number of lines per inch to match any reed.

Textile chemistry

The built-in lubrication process for enhancing abrasion and tear properties of cross-linked celluloses, developed at the Shri Ram Institute for Industrial Research (SRIFIR), Delhi, has attracted much attention. With a view to transforming laboratory findings into commercial practice considerable large scale work was done in textile mills on a wide variety of fabrics. N. B. Sattur, I. Hussain and R. C. Gupta of SRIFIR have shown that the process can be scaled up to industrial scale. The suitability of the process from the point of view of shade and tone changes of dyes and possible formation of oxycellulose, etc. has been established.

Textile physics

Discussing the influence of crystallinity and crystallite orientation on the birefringence of native cellulosic fibres with cellulose I lattice, K. R. Krishna Iyer (ATIRA) and T. Radhakrishnan (IJIRA) conclude that the intrinsic birefringence of amorphous cellulose is demonstrably lower than that of crystalline cellulose I.

Research and Development for Self-Reliance in Engineering Industries

Get-together at CMERI

With a view to identifying research and development problems of the mechanical engineering industries and to finding out ways and means of harnessing the institute's expertise and facilities to the best advantage of the industries, the Central Mechanical Engineering Research Institute (CMERI), Durgapur organized the get-together on 8 March 1970. Attended by over 150 delegates representing executives in industries, educationists and research workers, the get-together was held in two sessions—general and technical. In his inaugural address, Dr Atma Ram, Director General, Scientific & Industrial Research, dilated on how the research institution and industry could complement each other's efforts to generate indigenous technical know-how.

Problems faced by industries and the scope for resolving them in the national laboratories were dealt with by a number of speakers who included: Shri T. R. Gupta, Chairman, Executive Council, CMERI; Dr A. K. De, Director, CMERI; Dr H. Trivedi, Consulting Engineer; Dr A. K. Bose, General Manager, Alloy Steel Plant, Durgapur; Shri K. C. Chowdhury, RDSO, Lucknow; Shri K. Ramachandran, Ashok Leyland, Madras; Dr A. Bhattacharyya, Professor of Mechanical Engineering, Jadavpur University; Dr A. Lahiri, Director, CFRI, Dhanbad; and Dr V. A. Altekar, Director, NML, Jamshedpur.

Shri C. Chalapati Rao, Chairman, Heavy Engineering Corporation, Ranchi, in his presidential speech, called upon the industrialists to make increasing use of the expertise and facilities available at CMERI.

The technical session met under three groups, viz. (i) Metal forming, metal cutting and welding machinery; (ii) Refrigeration and air-conditioning; and (iii) Agricultural machinery and automobile engineering.

Metal forming, metal cutting and welding machinery

The group recommended the following types of machines for development by CMERI: (i) plastic extrusion and processing machinery, (ii) electrochemical and spark erosion machinery, (iii) resistance welding equipment such as spot, seam and butt welding machines, (iv) foundry equipment such as shell moulding machines, injection moulding machine, etc., (v) sand testing equipment, (vi) simple digital numerical control machines, and (vii) barbed wire making machines, spring coiling machines, coolant pump, and cold forming and deep drawing equipment.

Refrigeration and air-conditioning

The group discussed at length the technological aspects and the proposed project on refrigerated transport, which would be pursued on a national priority basis.

The group recommended that the following projects should be added to the research programmes of the institute: (i) creation of facilities for evaluation of refrigeration compressors up to 15 tons; (ii) creation of facilities for testing of package type air-conditioning units up to 10 tons capacity; (iii) design and development of small cold room having self-contained air-cooled refrigeration units for use by small farmers, (iv) measurement of thermal

conductivity of insulating materials at low temperatures; and (v) development of Bundy tubing.

This group recommended the setting up of a research institute for the refrigeration and air-conditioning industry, and suggested that necessary details should be worked out. The facilities and expertise available with the Refrigeration and Air-conditioning Section of CMERI should provide the basic nucleus for the organization.

Agricultural machinery and automobile engineering

The group suggested that CMERI should concentrate on problems which will benefit the entire industry rather than a single industrial concern. These include: (i) testing facilities for noise, filtration, etc. and machine components; (ii) noise reduction, filtration technique, corrosion problems, fastener techniques, etc.; and (iii) substitution with indigenous materials.

The group also suggested that CMERI should enter the field of systems engineering. Areas where systems engineering could be taken up are : (i) mechanization of road building; (ii) food storage, transport and processing; (iii) logging and movement of wooden logs; and (iv) cleaning of cities. It was suggested that the institute should play the role of consultants doing the general part of the design and selling of the concept to the customers, leaving the design of system components preferably to the industry.

It was also recommended that product design and development need not be taken up by CMERI if it brings the product in competition with other existing Indian products. The institute may however take up design and development work in cases where similar Indian products do not exist, and also when designing the complete system, where all the concerned products may not be available in the country. Similarly, when the design and development of a product is expected to benefit a large part of the public, product design and development may be taken up on a very selective basis. When it undertakes the design and development of a product, the institute should continue to provide the collaborating industry consultancy for a few years after the product goes into manufacture in order to take it to a stage of perfection.

NAL Annual Report : 1968-69

The commissioning of the 4-ft trisonic wind tunnel as a fully integrated system and the completion of the flow calibration in all the three speed regimes are the major items of work of the National Aeronautical Laboratory (NAL), Bangalore as is revealed in its annual report for 1968-69 just published. With the completion of this calibration, a modern wind tunnel facility essential for aeronautical industrial development activity in India has been established.

Seventy-six research and development projects were in progress. Some projects related directly to specific requirements of the Hindustan Aeronautics Ltd (HAL), while others, were of a more general nature but relevant to industry in the coming years.

The main research in aerodynamics centred around the 4-ft tunnel in order to make it operational for industrial development work in India. A major test programme on the 4-ft wind tunnel is expected to be the testing of an aircraft model of HAL.

In the structural sciences the main areas of activity continued to be industrial mechanics, fracture mechanics and fatigue. Matrix methods of structural analysis were applied to aeroelastic problems relating to panel flutter. The electro-hydraulic random load fatigue testing machine was completed. Experiments on aircraft metals were continued with a view to evaluating fatigue life, fracture, crack propagation rates and delay periods in crack growth.

In the field of materials science, investigations were undertaken on the acceleration of stress corrosion cracking. Rocket nose cones with embedded antenna wires for 'Rohini' RH-75 rockets were fabricated for use at the Thumba Equatorial Rocket Launching Station. The filament winding technique was being developed for making fibre reinforced plastic pressure vessels with end closures. An advanced model of a filament winding machine capable of fabricating 8 ft long cylinders up to 30 in. diam. was designed.

In the Propulsion Division the aerodynamic design of a three-stage turbine power pack working on compressed air was completed. A flame stabilization test rig working on opposed jet principle was commissioned and calibrated. Theoretical and experimental investigations were carried out on the discharge coefficient of a convergent nozzle at various pressure ratios at the request of the Gas Turbine Research Establishment, Bangalore. Tests on different samples of propellents were undertaken and completed at the instance of the Space Science Technology Centre, Thumba.

Improvements were made in the digital voltmeter (DVM) designed earlier, and a 4-digit version of DVM was developed. This instrument has a readout time of 6 millisecond and uses the digital circuits developed by the laboratory. An inexpensive solid-state power controller capable of controlling 1 kW of power from a dc signal of a few millivolts was developed. A general purpose 20-amplifier analogue computer was completed. The computer was used in studies of temperature and other control systems.

In the field of instrumentation, an electronic control system was designed and fabricated for use on the random load fatigue testing machine. A 48-channel pressure measuring system and several electromagnetic vibration pick-ups were made for use in the laboratory. A 100-channel bridge balancing system was designed and fabricated for the Structural Engineering Research Centre, Roorkee.

Basic research programme on transonic and hypersonic flows, space physics, electric analogy, ionized gas flow and shock waves was continued.

A pilot plant for making digital systems and components was started during the year under review. Fabrication of a special purpose data logging system for the Research Designs and Standards Organization, Lucknow was taken up. Electrical transducers and measuring instruments produced on another pilot plant included: (1) LVDT pressure and displacement transdu-

cers and associated electronic amplifiers, (2) single channel strain indicator, and (3) single channel thermocouple amplifier. The development of these was complete up to the manufacturing stage and the know-how and technology were released to industry. Twelve different types of devices and 16 types of instruments worth over Rs 2 lakhs were fabricated during the year.

The know-how concerning the following devices and equipment was ready for release to industry: (1) strain measuring bridge, (2) vibration meter, (3) vibration pick-up, and (4) rotating cantilever type fatigue testing machine.

Thirty-three research papers were published during 1968-69. The following patents were accepted: (1) improvements in or relating to spark erosion machine; (2) construction of a filament winding machine for fabrication of filament wound fibreglass reinforced plastic cylinders; and (3) construction of a rotating cantilever type fatigue testing machine.

CSMCRI Annual Report 1968

The main areas of work in which considerable progress was made by the Central Salt & Marine Chemicals Research Institute (CSMCRI), Bhavnagar during the year 1968 were in respect of salt, potassium chemicals, magnesium chemicals, trace alkali metals, water desalination, marine algae and sea water agriculture. A significant contribution in the field of salt research, as is revealed in the annual report of the institute just published, is the development of salt fortified with nutrients like calcium, iron and iodine. Large scale production of salt fortified with calcium as well as nutritional and consumer acceptability trials of the product were in progress. The target production of 10 000 tonnes of salt was achieved at the experimental salt farm of the institute. The quality of salt produced conforms to the IS Specification for industrial salt.

A sponsored project on the production of potassium carbonate through reduction of potassium sulphate was completed and the process was passed on to industry. An ion exchange process for the recovery of potassium chloride from distillery spent wash liquor was developed in collaboration with a sugar factory. Investigations on the scaling up of the processes for the preparation of pharmaceutical grade magnesium hydroxide from sea bittern and for the preparation of seawater magnesia were carried out.

Studies on the estimation of minor constituents of brine such as rubidium, lithium, cesium, arsenic and boron were made. Crude borax from Pugga valley (Kashmir) was found to contain appreciable amounts of lithium and cesium. A combination of chromatographic and neutron activation techniques was adopted for estimating cesium. A novel method worked out for the removal of radioactive fission fragments like ^{137}Cs, ^{90}Sr, ^{106}Ru, ^{131}I and ^{65}Zn from contaminated seawater using seaweeds, freshwater algae and fish is of particular significance.

An important field of research in which the institute intensified its efforts was the conversion of saline water into freshwater. Solar stills would be useful for providing drinking water in isolated places where power is not available. A solar still, based on the design supplied by CSMCRI, was set up and operated at the Navinar lighthouse. The still is meeting the requirements of drinking water at the lighthouse. An electrodialysis pilot plant (capacity, 15 000 litres/day) using indigenous membrane was set up at Morvi in collaboration with an engineering firm and operational data were collected.

Another promising technique for desalination of water is reverse osmosis. Comprehensive basic and applied studies were undertaken on the development of membranes, design and fabrication of experimental and pilot plant units as well as their performance.

With a view to disseminating information on the technique of water desalination, the institute set up a 'Desalination Information Centre' at its premises.

Cultivation of seaweeds for enhancing the resources of the agar bearing marine algae, as also cultivation of crops on sandy soils using seawater, are the two projects of national importance in which the institute obtained encouraging results. A field station for carrying out research on algae was established at Veraval (Saurashtra). Experiments on seawater irrigation on artificially prepared sand beds of bajra and maize showed that bajra can grow with insignificant reduction in growth, whereas maize cannot tolerate seawater (15 000 ppm salts).

Patents relating to (i) manufacture of iodized common salt, and (ii) mechanical salt harvester were filed. Over 80 technical papers were published by the institute.

Illumination Climate in South East Asia

At the instance of the Unesco sponsored Asian Regional Institute for School Building Research, Colombo, the Central Building Research Institute (CBRI), Roorkee conducted a series of measurements on sky luminance and daylight availability in several South East Asian countries. The objective was to provide designers and architects data for the design of fenestration for daylighting, especially for teaching spaces.

A preliminary survey was made in 1967 by Dr V. Narasimhan of CBRI of the possibilities of such work in the Far East with the collaboration of the universities in the region. Work was later started in 1968 at Colombo, Singapore, Bandung, Manila, Hong Kong and Taipei with the instrumentation provided by CBRI.

The data for the one-year period have been analysed, and a report has been submitted to the Asian Regional Institute for School Building Research, Colombo.

Although the region is entirely in the tropical belt, considerable variations are noticeable in the illumination climate as one moves from Colombo to Taipei. The consequent impact on the design for daylighting arises in terms of the design skies and availability of daylight outdoors. The design skies, the design solar altitudes, the availability of outdoor daylight, the location of the minima of sky luminance at design time and the ratio of minima of sky luminance to diffuse illumination are important factors in daylighting design.

The work provides for the first time a basis for the design for daylighting of teaching spaces for the vast areas covered by the South East Asian regions of Unesco. The full report will be published by Unesco.

CSIR SUPPORT TO RESEARCH

Schemes in Progress

Nature of Metal-Sulphur Bond in Metal Complexes

A CSIR scheme entitled 'Theoretical and experimental study of the nature of metal-sulphur bond in metal complexes', functioning under the purview of the Chemical Research Committee, is being investigated at the Department of Chemistry, Indian Institute of Technology, Kanpur since 1966. The investigator incharge is Dr U. C. Agarwala, and the research fellow, Miss Lakshmi.

Experimental as well as semi-theoretical approaches were made to understand the nature of metal-sulphur bond. The vibrational spectra of metal complexes were interpreted using normal coordinate analysis. The vibrational spectrum of bis (diethylxanthate)-Ni(II) xanthates, the interpretation of which was controversial so far, was studied in the light of normal coordinate analysis and the regions of four bands, the xanthate bands, were characterized. In xanthates where the thiocarbonyl group is attached to a mercaptide group, the electron density is delocalized and electron cloud is spread over $O-C=S_2$ moiety.

A similar approach was extended to the vibrational spectra of bis (cis-1, 2-dicyanoethylene-1, 2-dithiolato)-Ni(II) and bis(N-cyanodithiocarbimate)-Ni(II) and satisfactory potential energy distributions were obtained for all the coupled vibrations.

It is not known with certainty whether metal-sulphur bond is entirely covalent or partially covalent. Also, it is not definite whether there is back-bonding between metal and sulphur. To understand the nature of metal-sulphur bond, the complexing properties of various metal ions in different oxidation states with ligands containing sulphur as donor sites were studied. The ligand chosen for this purpose is quinazoline (1H, 3H)-2,4-dithione. The metal ions used for complexation are Ni (II), Co (II), Cu (II), Hg (II), Cd (II), Pt (II), Pt (IV), Pd (II), Pd (IV), Rh (II), Rh (III), Ru (I), Ru (II) and Ru (III). The structures of these metal complexes were established with the help of infrared, visible spectra and magnetic susceptibility measurements.

Other ligands used are 1-substituted phenyltetrazoline-5-thiones, viz. *p*-iodophenyltetrazoline-5-thione, *p*-bromophenyltetrazoline-5-thione, *m*-chlorophenyltetrazoline-5-thione, *p*-methoxyphenyltetrazoline-5-thione, and *o*-methylphenyltetrazoline-5-thione. Their complexing properties with the rare earth ions, Nd (III), Pr (III) and La (III) were studied. On the basis of infrared and visible spectra and magnetic susceptibility measurements the structures of the complexes were established. In all these complexes the metal-sulphur link possesses a fair amount of covalent character as shown by their positions in the nephelauxetic series.

The decomposition of some rare earth carbonates and their mass spectral analysis were carried out by mass spectrometer. The isotopic effect in the decomposition is being studied.

Research Papers

Vibrational spectra of xanthate complexes, P. Bhaskara Rao, U. Agarwala and Lakshmi, *Inorg. Chim. Acta*, **2** (1968), 337.

Chelating behavior of quinazoline (1H, 3H), 2-4-dithione, B. Singh, U. Agarwala and Lakshmi, *Inorg. Chem.*, **8** (1969) 134.

Lunar Tides in Equatorial Sporadic-E Ionization

Noon values of the critical frequency foEs of the q-type sporadic-E layer of the ionosphere at Kodaikanal were studied to find lunar tidal effect, if any. The analysis was carried out for 3 years of high solar activity (1957-59) and 3 years of low solar activity (1963-65).

The variation in high sunspot years was predominantly semidiurnal and agreed in phase with that of the H-component of the earth's magnetic field. The agreement was much better for the blanketing frequency fbEs than for foEs. Since fbEs is found to be nearly equal to the critical frequency foE of the normal E layer, it is concluded that the currents are responsible for lunar variation of the earth's magnetic field flow in the E-region of the ionosphere.

In low sunspot years, the amplitude of the semidiurnal lunar variation of foEs reduced to about one-third of that in high sunspot years, but no such change was observed in the diurnal component. In contrast, the phase of lunar semidiurnal (L2) variation of foEs remained almost the same in high as well as low solar activity, while that of diurnal variation changed by 6 to 9 hours (earlier hours in low solar activity). The L2 variation of foEs has maxima at about 1000 and 2200 lunar hr and amplitude of about 42 kHz in sunspot maximum and about 12 kHz in sunspot minimum. It was about 16 kHz for fbEs (or foE) in high sunspot years. No data of fbEs were available in low sunspot years.

The study was carried out by Miss B. K. Joshi, CSIR research fellow (until Sept. 1969), under the guidance of Dr K. M. Kotadia of the Department of Physics, Gujarat University, Ahmedabad.

Culture of Organs and Cells of T. foenum-graecum

The fenugreek *Trigonella foenum-graecum* (Methi) is cultivated extensively in India not only for greens but also for medicinal purposes. In view of its economic importance an attempt was made under a CSIR scheme to culture organs and cells of this plant at the Indian Institute of Science, Bangalore. The study was made by Shri K. C. Gupta, a CSIR research fellow.

Optimal growth of the cells was observed in Murashige and Skoog medium supplemented with coconut milk and casein hydrolysate. Two cell lines, one from a hypocotyl slice and another from a flower, were established. The optimal temperature for growth was 23°C, and illumination had no effect on the growth. 2, 4-Dichlorophenoxyacetic acid (2, 4-D) inhibited the growth of cells. Substitution of indoleacetic acid (IIA) with 1-naphthylacetic acid (NAA) induced the formation of compact calli.

Attempts to induce organogenesis by varying IAA/kinetin ratio and by increasing the nitrogen concentration in the medium were not successful.

Histogenesis of callus revealed that it is generally the cells of the pericycle of the hypocotyl explants that proliferated and gave rise to callus. In rare instances the cortical cells and the vascular parenchyma were found to give rise to an entire callus or part of a callus. The cells of callus in the later stages of development were seen to be organized in the form of nodules. Each nodule at maturity had a central core of tracheid-like cells with an envelope of meristematic cells.

During an exploration of the utility of various dyes it was found that Harris' alum haemotoxylin gave a crisp staining of chromosomes in cultured cells. The procedures were standardized for the use of fresh as well as acetic alcohol fixed material.

Detailed cytological investigations were limited only to the cells from the primary and the 12th subculture. While there was considerable variation in the size of cells and their nuclei in primary cultures, those from the 12th subculture were more uniform. Usually the division figures were normal. Occasionally chromosomal aberrations like ana- and telo-phase bridges were observed.

The growth of the shoot tips was found to be normal in Murashige and Skoog medium supplemented with coconut milk but lacking either kinetin or IAA. Addition of gibberellic acid produced elongation of the internodes. Incorporation of casein hydrolysate resulted in a dedifferentiation. Surprisingly no root formation was observed during the growth of the plantlets in culture.

The establishment of root clones failed owing to the formation of less number of slow growing lateral roots. Methods to induce lateral root promotion failed.

Excized roots, grown in the liquid medium of White, exhibited the maximum growth on 6th day. Even mild illumination was inhibitory to their growth. Optimal conditions for their growth were: temperature, 23°C; *p*H 4·0; and sucrose concentration, 1·5%. Organic complexes like casein hydrolysate, coconut milk and yeast extract; vitamins like ascorbic acid and inositol; amino acids like arginine, citrulline and lysine, and a purine derivative, hypoxanthine, inhibited the growth of excized roots. Auxins and kinetin also inhibited the growth and in addition induced a dedifferentiation at their basal cut ends. The roots were thin and coiled when gibberellic acid was present in the medium.

The action of *p*-dichlorobenzene, α-bromonaphthalene and colchicine on seeds, seedlings and excized roots was evaluated. *p*-Dichlorobenzene facilitated studies on the chromosomes. The roots of seedlings exhibited no morphological or cytological changes when exposed to α-bromonaphthalene. Colchicine arrested the movement of chromosomes at metaphase and produced c-tumour. Micronuclei formation and later degeneration of such nuclei were common.

Incorporation of colchicine in the medium was found to be deleterious to the excized roots. There was a gradual decline in the mitotic activity during the period of recovery of the treated roots. A nucleolus was observed in every micronucleus formed.

The work was the subject matter of Ph.D. thesis of Shri K. C. Gupta. The thesis is entitled, 'Culture of organs and cells of *Trigonella foenum-graecum* Linn. and their cytology'.

Research Papers

1. Histogenesis, organogenesis and morphogenesis in callus cultures of *Trigonella foenum-graecum* Linn. and *Vigna unguiculata* (Linn.) Walp., *Curr. Sci.*, **37** (1968), 398.
2. A simple squash technique for the tissue cultures of *Trigonella foenum-graecum* Linn., *Curr. Sci.*, **39** (1970), 40.

PROCESSES READY FOR COMMERCIAL UTILIZATION

Resins as Fillers for Leather

India is the largest producer of raw hides and skins. But the quality of leathers produced from them is poor. Till recently, the country exported considerable quantities of raw hides and skins; gradually there was switch-over to the production of crust and half-tanned leathers for export. Nowadays the export market has a good demand for good quality finished chrome upper leathers. From the existing raw hides and skins it is difficult to produce full and tight grained upper leathers. The defects can be overcome by retanning the leathers with either synthetic or vegetable tanning agents. Leathers produced by this process, though full, do not possess chrome feeling or grain tightness. If synthetic resins are impregnated into the leather, they produce the desired characteristics. The resins are generally prepared from amides in such a way that they are soluble in leather and stable during storage. The amino resins have the drawback of instability.

The conventional resins that are available in the market are precondensed ones, and are precipitated *in situ* with acids. With these resins, however, there are certain risks during application. The tanner may spoil the leathers by precipitating the resins on the grain thereby making dyeing and fatliquoring operations difficult. Also hard and cracky leathers may result.

The Central Leather Research Institute (CLRI), Madras has developed a series of resins which are soluble in water and stable over a very long period. Other advntages of the products developed by CLRI are that liberation of formaldehyde is prevented and grains do not crack. The process has been worked out on a laboratory scale.

The present production of fillers for leather in the country is insignificant and most of the requirement is met by import. The present demand for fillers is estimated at 150 tons/annum and with the indigenous production, the demand may rise to 400 tons/annum.

The main raw materials needed are urea, formaldehyde, sodium metabisulphate, dicyandiamide, ammonium chloride, sulphuric acid, caustic soda, hydrochloric acid and glycerol. All these are available indigenously.

Jacketed stainless steel reactor with stirring arrangement and fitted with condenser and boiler are the main items of equipment needed.

The cost of production of the fillers works out to Rs 4 and 7/kg depending on the type of the product. The process can be taken up with advantage by an organization engaged in the manufacture of urea-formaldehyde resins or other amino-plastics.

Parties desirous of taking up commercial exploitation of the product may correspond with the Secretary, National Research Development Corporation of India, Mandi House, Lytton Road, New Delhi 1.

Mechanical Engineering Bulletin

With a view to bridging the communication gap between itself and the mechanical engineering industry the Central Mechanical Engineering Research Institute (CMERI), Durgapur, whose main scope and functions are aimed at helping the growing Indian engineering industry in the solution of mechanical engineering problems through design and development of machinery and components, has started publishing a quarterly bulletin under the title *Mechanical Engineering Bulletin*. Intended primarily to bring to the notice of industry and entrepreneurs the progress of research and development effort at CMERI and its regional centres (MERADO), the bulletin will also serve as a forum for the views of the industry, planners and research workers outside CMERI to provide guidelines for framing the institute's scientific policies and research and development programmes. Major developments in the field of mechanical engineering will also be featured in the bulletin for the benefit of industry.

The first issue (February 1970), brought out recently, contains three research papers contributed by the scientists of the institute. The scope and functions, and major achievements of the institute, and the developmental and evaluation facilities obtaining at CMERI are dealt with in a general article entitled, 'CMERI serves industry'. Another article deals with mechanical engineering research and development organization (MERADO) centres set up with the assistance of the United Nations Development Programme.

Two regular sections of the bulletin comprise 'Entrepreneurs Page' and 'News and Views'. Some of the equipment and instruments developed by CMERI and available for commercial utilization, such as dc chopper amplifier, preset counter, line voltage regulator, electric cradle dynamometer, are described in the section, Entrepreneurs Page of the issue under review. The News and Views section covers seminars and conferences of particular interest to the mechanical engineering industry.

Major world developments in the field of mechanical engineering are also covered in this section. The present issue, for instance, reports an improved technique for detecting welding flaw during operation, developed at the Richard Laboratory of the Battelle Memorial Institute, USA.

Subscription rates for a single copy of the journal (demy 4to) are Rs 3.00 (inland) and Sh 6, $0.90 (foreign).

Prof. S. J. Arceivala

Prof. S. J. Arceivala, Director, Central Public Health Engineering Research Institute (CPHERI), Nagpur recently visited Bangkok in the capacity of WHO Temporary Adviser to assist in conducting the seminar organized by WHO on Rural Water Supply held at Khon-Kaen from 4 to 14 March 1970. Delegates from Thailand, India, Ceylon, Nepal and Indonesia attended the seminar. Besides delegates, there were many observers, and in all, about 40 participants.

The seminar was organized to focus the attention of the South East Asian countries to the enormous task facing them, viz. providing safe and adequate water supplies to their fast increasing populations.

Prof. Arceivala took this opportunity to present a paper on 'Rural Sanitation' and explained the work done by CPHERI, Nagpur on the various aspects of rural water supply and waste water disposal. The participants evinced interest in the chloroscope developed by CPHERI for ensuring proper disinfection of community water supplies by chlorination. The simple chloroscope, designed and fabricated by the institute, costs only one-tenth that of some of the imported models. Since such instruments are required in large numbers by all countries, there is considerable scope for marketing them in these countries.

Panel of Scientific Translators

The Indian National Scientific Documentation Centre (Insdoc), New Delhi has organized a panel of translators for translating scientific and technical literature from foreign languages into English. Scientists, engineers and technologists having a high proficiency in foreign languages, especially Russian, who are willing to take up translation work from foreign languages into English in their own field of specialization in their spare time may write to the Scientist Incharge, Insdoc, Hillside Road, New Delhi 12. Persons enrolled on the panel will be given translation work on a part-time basis and will be paid for at the rate of Rs 6 per page of English translation (300 words).

Prof. Arceivala also explained to the participants the recent work done by the institute on defluoridation of water supplies and removal of iron and manganese from rural water supplies.

During his stay, Prof. Arceivala also took the opportunity to visit the Bangkok Water Works, the Bangkok Composting Plant and the Asian Institute of Technology where interesting experiments are in progress on algae harvesting for animal feed—a field in which CPHERI is also interested.

PATENTS

ACCEPTED

116675: Improvements in or relating to polymers possessing polyamide linkages for plastics, fibres and like industrial applications, N. D. Ghatge, S. B. Patil & V. S. Patil—NCL, Poona.

116762: A process for the utilization of mammalian intestines for the manufacture of absorbable surgical catgut/suture/ligature 'plain and chromic' or the like, S. K. Barat & M. Kumar—CLRI, Madras.

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